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CODE OF PRACTICE FOR DESIGN OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3 *July* 1971

Indian Standard

CODE OF PRACTICE FOR DESIGN OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

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AMENDMENT NO. 1 APRIL 1972
TO
IS : 5978-1970 CODE OF PRACTICE FOR DESIGN OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

Corrigenda

(*Page* 7, *Table* 1)

a) *Col* 8, *against Sl No.* 16 — Substitute ' 360 ' *for* ' 355 '.

b) *Col* 9, *against Sl No.* 29 — Substitute ' 65 ' *for* ' 85 '.

[*Page* 11, *clause* 8.8, *value of* (d_e) — Substitute the following for the existing matter:

$$(d_e) = \left\{\begin{matrix}\text{diameter}\\ \text{at top}\\ \text{in cm}\end{matrix}\right\} + \frac{L_t - L_e + 0{\cdot}9}{(L_t - 1{\cdot}8)\,0{\cdot}9}\left[\left\{\begin{matrix}\text{diameter at}\\ 1{\cdot}8\text{ m from}\\ \text{butt in cm}\end{matrix}\right\} - \left\{\begin{matrix}\text{diameter}\\ \text{at top}\\ \text{in cm}\end{matrix}\right\}\right]$$

(BDC 9)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 FEBRUARY 1974

TO

IS : 5978-1970 CODE OF PRACTICE FOR DESIGN OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

Alterations

(*Page* 4, *clause* **3.1**, *equation against* 'Le') — Substitute '($Le = Lf - Lg + 0{\cdot}3$ m)' *for* '($Le = Lf - Lg$)'.

(*Page* 6, *clause* **8.1**)

a) *Line* 2 — Substitute 'IS : 5613 (Part I/Sec 1)-1970*' *for* 'IS : 802 (Part I)-1967*'.

b) *Foot-note with* (*) *mark* — Substitute the following for the existing foot-note:

'*Code of practice for design, installation and maintenance of overhead power lines: Part I Lines up to and including 11 kV, Section 1 Design.'

(BDC 9)

Indian Standard

CODE OF PRACTICE FOR DESIGN OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 18 September 1970, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Supports made of steel have been largely used in India for overhead power transmission and distribution lines and for telecommunication lines. Wood poles are often more economical than steel supports, particularly for secondary transmission and distribution and telecommunication lines. With a view to making the best possible use of available indigenous materials and ensuring possible reduction in the ultimate cost of power and communication facilities to the people of this country, Indian Standard Specification for wood poles (IS : 876-1957) was formulated, which was revised in 1961; covered besides specifications portion and also the design aspect. This design aspect (given in Appendix E of IS : 876-1961) has been deleted from the second revision of IS : 876 and the same is now covered in this standard. This has been done so as not to mix design aspect with specification, since these are not related to each other.

0.3 In the preparation of this standard considerable assistance has been rendered by Forest Research Institute and Colleges, Dehra Dun, and the Central Water and Power Commission.

0.4 In the formulation of this standard due weightage has been given to the practices being followed in the field in this country.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers method of design of wood poles made of both broad-leaved and coniferous species of timber, grown in India suitable for carrying overhead electric power transmission lines, telephone and telegraph circuits both for solid and jointed wood poles (*see* Note).

Note — The detailed specifications of full size wood poles and jointed wood poles made of broad-leaved and coniferous species of timber suitable for carrying overhead electric power transmission lines, telephone and telegraph circuits are covered respectively in IS : 876-1970* and IS : 6056-1970†.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 707-1968‡ shall apply.

3. SYMBOLS

3.1 For the purpose of this standard, the following letter symbols shall have the meaning indicated against each:

d_e = effective diameter of the pole in cm.

D_G = diameter of the pole at the ground level in cm.

D_T = diameter of pole at top in cm.

H = height of pole above ground level in m.

L_1 = height of highest conductor in m.

L_2 = height of next highest conductor in m.

L_f = full length of pole in m.

L_g = depth of setting of the pole in the ground in m.

L_e = effective length of the pole between top and 0·3 m below the ground line in m ($L_e = L_f - L_g$).

M = total overturning moment at the ground line in kg m.

M_{C1} = overturning moment due to wind pressure on top conductor in kg m.

M_{C2} = overturning moment due to wind pressure on next highest conductor in kg m.

M_p = overturning moment due to wind load on the pole in kg m.

P = design wind pressure for the region in kg/m².

P_C = wind pressure on each conductor in kg per metre run.

R = ultimate modulus of rupture in static bending in kg/cm².

S_1, S_2 = lengths of spans on each side of the pole in metres.

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*Specification for wood poles for overhead power and telecommunication lines (*second revision*).

†Specification for jointed wood poles for overhead power and telecommunication lines.

‡Glossary of terms applicable to timber and timber products (*first revision*).

4. SPECIES OF TIMBER

4.1 Timber suitable for wood poles is categorized into three groups, as indicated below, based on the modulus of rupture of small clear specimens (*see* IS : 1708-1969*) tested in the green state, that is, more than 25 percent moisture content:

Group A — Very strong timber having a modulus of rupture in bending of 850 kg/cm² and over

Group B — Strong timber having a modulus of rupture in bending of 630 to 850 kg/cm²

Group C — Moderately strong timber having a modulus of rupture in bending of 450 to 630 kg/cm²

NOTE — The categorization of timber into three groups, namely A, B and C, based on the modulus of rupture of small clear specimens in the green condition is for information only and does not directly relate to the strength classes of the poles which take into account the effect of naturally occurring defects and other characteristics of timber and increase in strength of wood poles due to proper seasoning and treatment.

5. CLASSIFICATION

5.1 The wood poles shall be classified in seven strength classes as under:

Class 1 — Ultimate breaking load not less than 1 350 kg

Class 2 — Ultimate breaking load not less than 1 100 kg and not more than 1 350 kg

Class 3 — Ultimate breaking load not less than 850 kg and not more than 1 100 kg

Class 4 — Ultimate breaking load not less than 700 kg and not more than 850 kg

Class 5 — Ultimate breaking load not less than 550 kg and not more than 700 kg

Class 6 — Ultimate breaking load not less than 400 kg and not more than 550 kg

Class 7 — Ultimate breaking load not less than 300 kg and not more than 400 kg

5.1.1 The above loads are assumed to be applied on full size poles as per method described in IS : 1900-1961†.

---

*Methods of testing small clear specimens of timber (*first revision*).

†Method of testing wood poles.

5.1.2 The species of timber suitable for wood pole are given in Table 1.

5.1.3 The approximate dimensions of wood pole for various classes arranged groupwise (*see* **4.1**) are given in Table 2, which have been obtained by taking modulus of rupture in green condition of small clear specimens of representative species of each group.

NOTE — The minimum load which a pole of a given dimension takes depends upon the modulus of rupture of species concerned given in Table 1, the uniformity of taper and also the cumulative effect of various defects, their location, etc.

6. PRINCIPLE

6.1 Wood poles shall be designed as simple cantilevers except when used as struts, cross arms or braces. The preliminary design of wood poles shall be based on the values of modulus of rupture in bending in the green condition, that is, moisture content more than 25 percent, which are given in Table 1. In the design and erection of the pole, it shall be ensured that most of the visible defects are, as far as possible, farthest away from points of maximum stress, which occurs at critical section (*see* **7.1.1**).

7. DESIGN CONSIDERATIONS

7.1 A wood pole, used as an overhead line support, is subject to static bending caused by the following loadings:

a) Wind load on the cylindrical surface of the pole above the ground, and

b) Wind load on the conductors and ground wires acting on the horizontal span.

7.1.1 A straight-line location is assumed for the sake of simplicity. The loadings in **7.1** result in an overturning moment which increases from the point of occurrence of the resultant load to the ground level. On account of the slightly increasing taper of the pole from the top to the ground line, the resisting moment of the pole increases correspondingly. The point of maximum stress occurs at critical section which occurs at the ground line or at the section where the diameter is equal to 1½ times the diameter at the point of occurrence of the resultant load, if the latter value is less than the ground line diameter.

8. DESIGN

8.1 The wind pressures on pole; conductors and wires shall be in accordance with IS : 802 (Part I)-1967* or in accordance with relevant statutory rules.

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*Code of practice for use of structural steel in overhead transmission line towers: Part I Loads and permissible stresses.

TABLE 1 STRENGTH OF VARIOUS SPECIES OF TIMBER

(*Clauses* 5.1.2 *and* 6.1)

Sl No.	Species		Areas from Where Species are Likely to be Available	Average Weight at 12 Percent Moisture Content	Strength in Green Condition			
					Static Bending		Maximum Crushing Stress	Shearing Stress
	Botanical Name	Trade Name			Modulus of rupture	Modulus of elasticity		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
				kg/m³	kg/cm²	1 000 kg/cm²	kg/cm²	kg/cm²
			GROUP A					
1.	*Bruguiera* spp.	**bruguiera**	Andamans	893	1 095	175	570	110
2.	*Hopea parviflora* Bedd.	**hopea**	Mysore, Tamil Nadu	995	930	130	530	115
3.	*Kayea assamica* King & Prain	**kayea**	Assam	801	1 080	145	580	115
4.	*Mesua ferrea* Linn.	**mesua**	Assam, Mysore, Tamil Nadu	995	1 190	170	625	130
5.	*Poeciloneuron indicum* Bedd.	**ballagi**	Mysore, Tamil Nadu	1 135	1 120	165	590	140
6.	*Shorea robusta* Gaertn. f.	**sal**	Assam, Bihar, Uttar Pradesh, Orissa, W. Bengal, Madhya Pradesh	815	845	125	425	85
			GROUP B					
7.	*Acrocarpus fraxinifolius* Wight et Arn.	**mundani**	Mysore	690	810	125	420	110
8.	*Calophyllum tomentosum* T. Anders	**poon**	Mysore	655	670	100	345	70
9.	*Calophyllum wightianum* T. Anders	**poon**	Mysore	685	675	85	350	85
10.	*Casuarina equisetifolia* Forst	**casuarina**	Mysore	850	730	115	325	115
11.	*Dalbergia sissoo* Roxb.	**sissoo**	Assam, Bihar, Orissa, Punjab, Uttar Pradesh, W. Bengal	770	785	85	380	115
12.	*Dipterocarpus grandiflorus* Blanco.	**gurjan**	Andamans	785	740	130	360	80
13.	*Dipterocarpus indicus* Bedd.	**gurjan**	Mysore, Kerala	785	790	165	410	80
14.	*Dipterocarpus macrocarpus* Vesque.	**hollong**	Assam	735	725	135	355	70
15.	*Dipterocarpus turbinatus* Gaertn.	**gurjan**	Andamans	785	775	140	410	70
16.	*Eucalyptus globulus* Labill.	**blue gum**	Tamil Nadu, Andhra Pradesh, Kerala, Mysore	850	795	150	355	95
17.	*Hardwickia pinnata* Roxb.	**piney**	Kerala, Mysore, Tamil Nadu	635	660	105	325	80
18.	*Heritiera minor* Lam.	**sundri**	West Bengal	1 038	820	140	400	115
19.	*Lagerstroemia lanceolata* Wall.	**benteak**	Kerala, Mysore, Andhra Pradesh, Tamil Nadu	610	635	110	325	75
20.	*Lagerstroemia parviflora* Roxb.	**lendi**	Bihar, Assam	755	710	110	350	100
21.	*Palaquium polyanthum* (Wall.) Engler.	**tali**	Assam	734	745	110	395	100
22.	*Pterocarpus marsupium* Roxb.	**bijasal**	Bihar, Bombay, Kerala, Madras, Madhya Pradesh, Mysore, Orissa, W. Bengal	800	745	105	365	85
23.	*Tectona grandis* Linn. f.	**teak**	Tamil Nadu, Andhra Pradesh, Kerala, Mysore	625	685	90	340	90
24.	*Terminalia bialata* Steud.	**white chuglam**	Andamans	705	775	125	395	80
25.	*Terminalia manii* King.	**black chuglam**	Andamans	800	840	125	415	100
26.	*Terminalia paniculata* Roth	**kindal**	Mysore, Kerala	800	750	120	390	85
27.	*Terminalia tomentosa* Wight et Arn.	**laurel**	Bihar, Orissa, Madhya Pradesh, Mysore	850	775	110	385	95
28.	*Xylia xylocarpa* Taub.	**irul**	Bihar, Orissa, Mysore	850	810	115	435	115
			GROUP C					
29.	*Borassus flabellifer* Linn.	**tad (palmyra)**	Tamil Nadu, Andhra Pradesh, Kerala, Mysore	815	525	90	400	85
30.	*Cedrus deodara* D. Don.	**deodar**	Himachal Pradesh, Jammu & Kashmir	545	610	95	315	65
31.	*Garuga pinnata* Roxb.	**garuga**	Himachal Pradesh	610	585	75	290	90
32.	*Lagerstroemia flosreginae* Retz.	**jarul**	Assam, Kerala, Mysore, W. Bengal	625	605	90	325	75
33.	*Lagerstroemia hypoleuca* Kurz.	**pyinma**	Andamans	610	605	85	305	75
34.	*Pinus roxburghii* Sargent	**chir**	Himachal Pradesh, Jammu & Kashmir	575	505	100	250	60
35.	*Shorea assamica* Dyer.	**makai**	Assam	575	555	95	285	80
36.	*Terminalia arjuna* W & A	**arjun**	Assam	815	610	75	300	100
37.	*Terminalia myriocarpa* Heurck et Muell. Arg.	**hollock**	Assam	610	595	95	305	75
38.	*Terminalia procera* Roxb.	**white bombwe**	Andamans	610	590	90	290	80

TABLE 2 DIMENSIONS OF WOOD POLES

(*Clauses* 5.1.3, 8.6 *and* 8.7)

Normal Height	Height Above Ground Level	Minimum Circumference at Ground Level																				
		Class 1, Group			Class 2, Group			Class 3, Group			Class 4, Group			Class 5, Group			Class 6, Group			Class 7, Group		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
m	m	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm
6·0	4·8	60	63	70	55	58	65	50	53	60	48	50	55	44	46	51	43	45	50	40	41	45
7·0	5·8	63	67	74	60	63	70	55	57	64	51	53	60	47	50	55	46	48	53	42	44	49
8·0	6·5	66	70	78	63	66	73	57	60	67	54	56	63	49	52	57	48	50	56	44	46	51
9·0	7·5	70	74	82	66	70	76	60	63	70	56	59	66	52	54	60	50	53	59	46	48	53
10·0	8·2	73	76	84	68	72	78	62	65	72	58	61	68	54	56	62	52	55	61	48	50	53
12·0	10·2	78	82	92	73	76	85	67	70	78	63	66	72	58	61	66	56	59	65	51	54	59
14·0	12·0	83	87	96	78	81	90	71	75	83	67	70	78	62	65	71	60	63	69	54	57	63
Minimum Circumference at Top for All Heights in cm		50	52	57	43	46	51	41	43	48	36	38	42	30	32	35	29	31	34	26	28	30

8.2 The overturning moment due to wind load on the wood pole shall be given by the following formula:

$$M_p = \frac{PH^2}{900} \times (D_G + 2D_T)$$

8.3 The overturning moment due to wind load on the wire shall be given by the following formulæ:

$$M_{C1} = P_C L_1 \times \frac{S_1 + S_2}{2}$$

$$M_{C2} = P_C L_2 \times \frac{S_1 + S_2}{2}$$

8.4 The total overturning moment at the ground line (M) is the sum of the overturning moments due to wind loads on the wires and on the pole, that is, $M = M_p + \Sigma M_C$.

8.5 The section modulus of the pole at the ground line shall be:

$$\frac{\pi D_G^3}{32} \text{ cm}^3$$

If the ultimate modulus of rupture in static bending of the particular species of the pole is R kg/cm², the ultimate resisting moment at the ground line shall be:

$$\frac{\pi D_G^3}{32} \times \frac{R}{100} \text{ kg m}$$

and the resulting factor of safety shall be calculated as:

$$\frac{\pi D_G^3}{32} \times \frac{R}{100} \times \frac{1}{M}$$

This factor shall not be less than the value prescribed by statutory rules in force or 2·5 whichever is higher.

8.6 The size of the pole for the given line shall be selected in accordance with the standard dimensions given in Table 2.

8.7 A safe working load corresponds to breaking load divided by the factor of safety; the total overturning moment at the ground line, due to wind load on the wires and the pole, may be converted to the equivalent load applied at 60 cm from the top and the proper size may be selected for the given duty from Table 2. To start with, the wind load on the pole may be ignored and the required pole dimensions shall be calculated to take care of the wind load in the wires only. Assuming this size of pole, the total overturning moment due to wind loads on the wires and support shall be calculated and this process shall be repeated by trial and error, if necessary, till the appropriate dimensions are determined.

8.8 Where stays are used, crippling load due to vertical components of the forces in the stays is calculated using the following formula and takes into account:

a) tapered sections,

b) imperfect rigidity of the ground, and

c) degree of stability of the pole-tops due to stays and line wires.

$$\text{Crippling load in kg} = \frac{4{\cdot}16\, d_e^4}{L_e^2}$$

$$(d_e) = \begin{Bmatrix} \text{diameter} \\ \text{at top} \\ \text{in cm} \end{Bmatrix} + \frac{L_f - L_g + 0{\cdot}9}{(L_f - 1{\cdot}8)\, 0{\cdot}9} \begin{Bmatrix} \text{diameter} \\ \text{at } 1{\cdot}8 \text{ m} \\ \text{from butt} \\ \text{in cm} \end{Bmatrix} - \begin{Bmatrix} \text{diameter} \\ \text{at top} \\ \text{in cm} \end{Bmatrix}$$

NOTE — These figures shall be used with caution specially for abnormally unstable grounds. As a good practice, it is recommended to select the straightest and stoutest poles of a given class to serve as poles with stays.

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5-8-56C L. N. Gupta Marg (Nampally Station Road), HYDERABAD 500001	23 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	6 34 71 6 98 32
117/418 B Sarvodaya Nagar, KANPUR 208005	21 68 76 21 82 92
Patliputra Industrial Estate, PATNA 800013	6 23 05
T.C. No. 14/1421, University P.O., Palayam TRIVANDRUM 695035	6 21 04 6 21 17

Inspection Offices (With Sale Point):

Pushpanjali, First Floor, 205-A West High Court Road, Shankar Nagar Square, NAGPUR 440010	2 51 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

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*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 27 68 00

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007 89 65 28

‡Sales Office in Bangalore is at Unity Building, Narasimharaja Square, Bangalore 560002 22 36 71

Reprography Unit, BIS, New Delhi, India